

**Delaware Department of Transportation
Division of Transportation Solutions
Design Guidance Memorandum**

Memorandum Number 1-30

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|--------------------------|----------------------------|----------------------------------|
| 1. Road Design Manual | 2. Bridge Design Manual | 3. Utilities Design Manual |
| 4. Real Estate Manual | 5. Standard Specifications | 6. Standard Construction Details |
| 7. Traffic Design Manual | | |

Title: Guidelines for Median Barrier on Divided Highways

Effective date: May 22, 2023

Sections to Implement:

<input checked="" type="checkbox"/> Project Development	<input checked="" type="checkbox"/> Planning	<input type="checkbox"/> DTC
<input checked="" type="checkbox"/> Bridge	<input checked="" type="checkbox"/> Engineering Support	<input checked="" type="checkbox"/> Traffic
<input type="checkbox"/> Right-of-Way	<input checked="" type="checkbox"/> Maintenance & Operations	<input checked="" type="checkbox"/> Construction
<input type="checkbox"/> Utilities		

I. Purpose

To define considerations for installation of median barrier on access-controlled and non-access controlled divided roadways in Delaware. A median is defined as the area between two roadways of a divided highway and is measured from the left edge of traveled way to the left edge of the opposing traveled way and is inclusive of median shoulders.

II. Background

The 2021-2025 Delaware Strategic Highway Safety Plan (SHSP) includes strategies and actions to reduce roadway departure crashes. A roadway departure crash is a crash in which a vehicle leaves the travel lane and strikes a fixed object, another vehicle, or overturns. These types of crashes include median crossover crashes where a vehicle departs the travel lane on one side of a divided highway, crosses through the median to the other direction of travel and strikes an oncoming vehicle, a fixed object, or overturns.

Between 2014 and 2016, roadway departure crashes accounted for 53% of all motor vehicle traffic fatalities nationwide¹. Between 2015 and 2019, nearly 28% of all fatalities and 16% of serious injuries in Delaware resulted from roadway departure crashes². Cross-median crashes (CMC), which are a type of roadway departure crash, are classified as a single-vehicle or multi-vehicle CMC. The multi-vehicle CMC is usually a violent, head-on crash that could result in serious injuries or fatalities. Based on an analysis of data from the Fatality Analysis Reporting System (FARS), approximately 8% of all fatalities on divided highways are the result of head-on crashes and research has shown that CMC are responsible for a disproportionately high rate of fatalities. The severity of cross-median crashes is often attributed to higher speeds typically occurring on divided highways. Studies have also shown where the median width is greater than 50 feet, the frequency of CMC that occur is sometimes higher than median barrier guidelines might suggest³. According to FHWA statistics, median barriers installed on rural four-lane highways result in a 97% reduction of CMC⁴. Refer to the Appendix for additional background information and research regarding national practices.

¹ <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812297>

² [2021-2025 Delaware SHSP](#)

³ [NCHRP Report 794](#)

⁴ [NCHRP Report 794](#)

III. Delaware Median Barrier Guidelines and Design Guidance

Based on the literature search conducted regarding median barrier guidelines, national guidance, research of other states practices and consideration of current median installation practices in Delaware (see Appendix), the following are being adopted as guidelines for the installation of median barrier on Delaware roadways.

These guidelines are applicable to those projects in the preliminary engineering phase that may involve new alignments, major rehabilitation of an existing facility, roadway widening, realignment, projects that modify existing designs to meet geometric criteria, or includes substantial changes to the character of the road (significant widening, realignment, major operational modifications). These guidelines are not applicable to most pavement & rehabilitation projects, bridge rehabilitation projects, maintenance projects, traffic signal modifications and are not subject to the existing roadway network where active design projects are not underway.

Upon review of the following considerations, the designer should coordinate with the Traffic Engineering Section to obtain concurrence with the decision to install or not install median barrier on a specific project.

- Median barrier should be considered on all medians of access-controlled facilities (Interstates, freeways, and expressways) regardless of median width and Annual Average Daily Traffic (AADT).
- On non-access controlled facilities within the limits of grade separated intersections:
 - Median barrier should be considered within the limits of all grade separated intersections where the posted speed on the “major” roadway is greater than or equal to 45 MPH. The “major” roadway is the roadway that will function similar to a controlled access facility after implementation of the grade separated intersection.
 - Median barrier may be considered within the limits of all grade separated intersections where the posted speed limit on the “major” roadway is less than 45 MPH. This consideration should be based on the roadway geometry, traffic volumes, median width, cross-median crash history, and the presence of pedestrians as median barrier is a potential strategy to minimize uncontrolled mid-block pedestrian crossings of the roadway.
 - Limits of the grade separated intersections are based on logical termini and the design guidance provided below. Median barrier should begin and end at the next remaining crossover or intersection upstream and downstream of the grade separated intersection.
- On non-access controlled facilities with at-grade intersections:
 - On non-access controlled facilities with at-grade intersections, median barrier should be considered based on an assessment of cross-median crash history, benefit/cost ratio, and based on any combination of factors that contribute to the probability of the occurrence of cross-median crashes including roadway geometry, traffic volume, at-grade intersection spacing, median width, intersection sight distance, and the presence of pedestrians as median barrier is a potential strategy to minimize uncontrolled mid-block pedestrian crossings of the roadway.

If median barrier is determined to be the method to minimize cross-median crashes, the following design guidelines are provided:

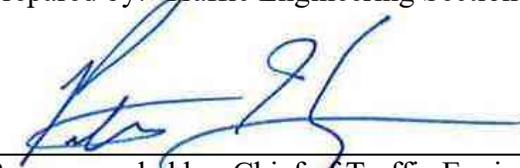
1. The type of median barrier should be based on the median width and median side slopes. High-Tension Cable Barrier (HTCB) is preferred where the existing median width is ≥ 30 feet. For medians less than 30 feet in width, double-faced W-beam (Type 3-31) guardrail or concrete barrier should be considered based on median width, median side slopes, posted speed limit, traffic volumes, and traffic composition.
2. Median barrier should be located based on the design requirements for the system chosen and should be located to minimize nuisance hits, especially along horizontal curves. Where feasible, the median barrier should be located closer to the travel lane along the outside of the curve to allow for more recovery area along the inside of the curve.
3. If HTCB is determined to be the appropriate median barrier for the project, the minimum length of HTCB is 1,000 feet between anchors. The maximum length between anchors is 10,000 feet.
4. The design plans should include provisions for appropriate crashworthy end treatments for the chosen median barrier, including details for concrete or asphalt pads for impact attenuator installation, if required.
5. On non-access controlled facilities, to provide for extended median barrier sections, consideration should be given to closing additional unsignalized median crossovers that have minimal left-turn or U-turn traffic volumes or a high rate of crashes.

IV. Justification

Median barrier is one proven countermeasure to minimize and/or reduce cross-median crashes. Median barrier should be considered for all divided roadways with open median sections, not only access controlled facilities. According to the *Highway Safety Manual*, installation of median barrier on multilane divided highways has a potential crash modification factor (CMF) of 0.57 (for fatal crashes) and 0.70 (for injury crashes). It should be noted that the presence of a median barrier does not eliminate crashes occurring in medians but may alter the character of those crashes. Constructing median barriers may result in an increase in total median crashes at a given location, however, it is expected that a reduction in cross-median crashes should result in a corresponding reduction in the severity of median-related crashes.

Prepared by: Traffic Engineering Section

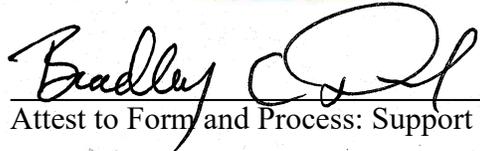
Date 3/8/2023



Recommended by: Chief of Traffic Engineering

5/4/2023

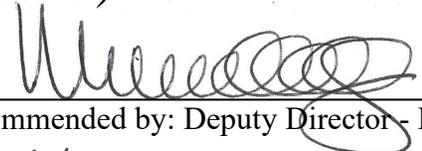
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Attest to Form and Process: Support Engineer

5/11/2023

Date



Recommended by: Deputy Director - Design

05/12/2023

Date



Approved: Chief Engineer

05/22/2023

Date

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Appendix

Median Barrier Guideline Research

Median crossover crashes occur on roadways with varying median widths, varying traffic volumes and varying speeds. Guidelines for median barrier installation are included in Figure 6-1 of the AASHTO *Roadside Design Guide* (presented as Figure 1 herein) which are applicable to access-controlled facilities, however, those guidelines are vague for median widths greater than 30 feet. Some states have developed their own median barrier guidelines which better define when median barrier should be installed. Since approval of the 2021-2025 Delaware SHSP, the Department began an effort to prioritize the need for median barrier on divided principal arterials where median crossover crashes have also occurred and reevaluate our internal guidelines for median barrier guidelines moving forward.

The following information presents research that was conducted to determine national practice in identifying guidelines for median barrier installation. This is for informational purposes only and does not reflect DelDOT practice. Section III, above, identifies Delaware specific guidance.

The AASHTO *Roadside Design Guide* (RDG), first published in 1989, typically recommended median barrier for locations where the median was less than 30 feet wide. However, crash data indicated that many States were experiencing a high frequency of CMC fatalities on highways with medians that exceeded 30 feet. The results of a National Transportation Safety Board (NTSB) crash report published in 2003⁵ indicated that the AASHTO RDG median barrier guidance did not adequately address

current high-speed, high-volume roadways. A 2004 FHWA survey found that a significant percentage of fatal cross-median crashes occurred where median widths exceeded 30 ft and approximately two-thirds of the crashes occurred where the median was less than 50 feet in width. The 4th Edition of the RDG, published in 2011, includes guidelines for median barriers on high-speed, fully controlled-access roadways. Figure 6-1 of the RDG recommends evaluating the need for barrier on fully controlled-access roadways with median widths 30 feet or less and average daily traffic (ADT) greater than 20,000 vehicles per day (vpd). For locations with median widths less than 50 feet and where the ADT is less than 20,000 vpd, the RDG suggests that a median barrier is optional. For locations where median widths are greater than 30 feet but less than 50 feet and where the ADT is greater than 20,000 vpd, the RDG suggestions that a cost-benefit analysis or an engineering study may be conducted to determine the appropriate application for median barrier installations.

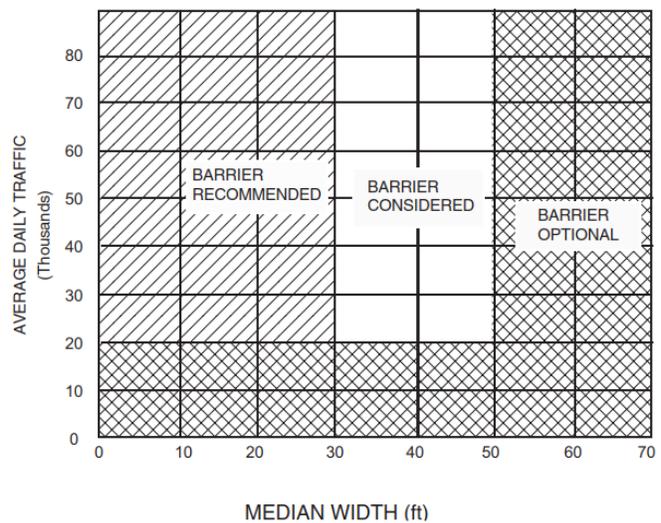


Figure 1: Guidelines for Median Barrier on High-Speed, Fully Controlled Access Roadways (Source AASHTO Roadside Design Guide, 4th Edition, Errata)

⁵ [NTSB Highway Accident Report 05/03](#)

In 2009, the Midwest Roadside Safety Facility (MwRSF) performed a review of median barrier guidelines for the Kansas Department of Transportation (KDOT)⁶. This study included a literature review of AASHTO guidelines for the installation of median barriers, a review of policy and freeway construction practice, as well as a summary of the median barrier guidelines used by other state DOTs (Figure 2). The cost-effectiveness of installing barriers in medians was evaluated based on median width and AADT. The study resulted in recommending updated guidelines for the installation of median barriers in medians up to 70 ft wide and supported revision to median barrier installation guidelines described in the RDG.

Agency	Response			
	Median barrier criteria			
California (2003)	Conduct study if median width is 0 to 20 ft and ADT exceeds 20,000 veh/day	Conduct study if median width is less than 75 ft and ADT exceeds 60,000 veh/day	Study any median with 0.5 cross-median crashes per mile per year or 0.12 fatal crashes per mi per year	
Florida	On Interstate, install barrier if median width less than 64 ft; 50 ft on other freeways	On Interstates and expressways, median barrier is required within 1 mi of exit/entrance gore with one or more cross-median crashes within 5 years		
Maine (2003)	Install barrier if the median width is < 20 ft and ADT > 20,000	Install barrier if median width is < 30 ft and ADT > 30,000 veh/day	Barrier optional if width is < 20 ft and ADT is 5,000 to 20,000 veh/day	Barrier optional if median width is 30 ft to 50 ft and ADT > 40,000 veh/day
Maryland	Install median barrier if width <= 30 ft	Install median barrier if width > 30 ft but < 50 ft and ADT > 40,000 veh/day	Install median barrier if width > 50 ft but < 75 ft and ADT > 80,000 veh/day	Do not install barrier if median width > 75 ft
New York	Install barrier if median width < 36 ft and ADT > 20,000 veh/day	Barrier encouraged if median width < 72 ft		Barrier is optional if median width is < 45 ft and ADT > 10,000 veh/day
North Carolina (2003)	Install barrier if median width < 70 ft			
Oregon	Install barrier if median width less than or equal to 60 ft; over 60 ft, base warrant on cross-median collision statistics			
Virginia	18 ft			
Washington	Provide median barrier on multilane highways with full access control with median widths of 50 ft or less and posted speeds of 45 mph or more	Consider median barrier on highways with wider medians or lower posted speeds when there is a history of cross-median accidents	Median barrier is not normally placed on collectors or other state highways that do not have limited-access control	
Wisconsin	On new freeway construction: range (median width, ADT) from (<= 20 ft, >= 20,000 veh/day) to (< 60-ft, >= 50,000 veh/day)	No retrofit warrant		

Figure 2: Median Barrier Criteria
(Source: NCHRP Report 794, TRB)

The Texas DOT sponsored a research study⁷ conducted by the Texas Transportation Institute (TTI) to determine appropriate guidelines for installation of median barriers on high-speed, controlled-access highways in Texas. The results of the study were based on an economic analysis of median crossover crashes and other median-related crashes occurring in Texas on Interstates, Other Freeways and Expressways and Principal Arterials. The resulting guidelines (Figure 3) are divided into four different zones defined by the combinations of AADT and median width. Each zone includes an associated cross-median crash rate that can be used to evaluate cross-median crash history on a selected highway section. The TTI research included a review of median barrier

⁶ [NCHRP Report 794](#)

⁷ [Median Barrier Guidelines for Texas](#)

guidelines for other states. This information was overlaid on Figure 3 for comparison purposes (see Figure 4).

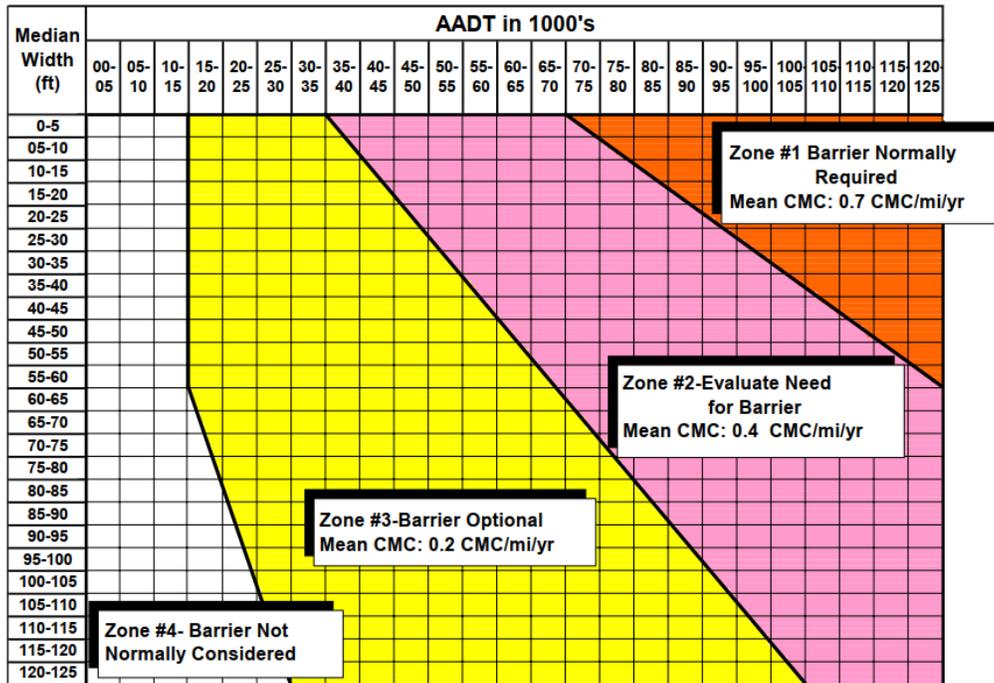


Figure 3: Recommended Guideline for Installing Median Barriers on Texas Interstates and Freeways (Source: Median Barrier Guidelines for Texas, TTI)

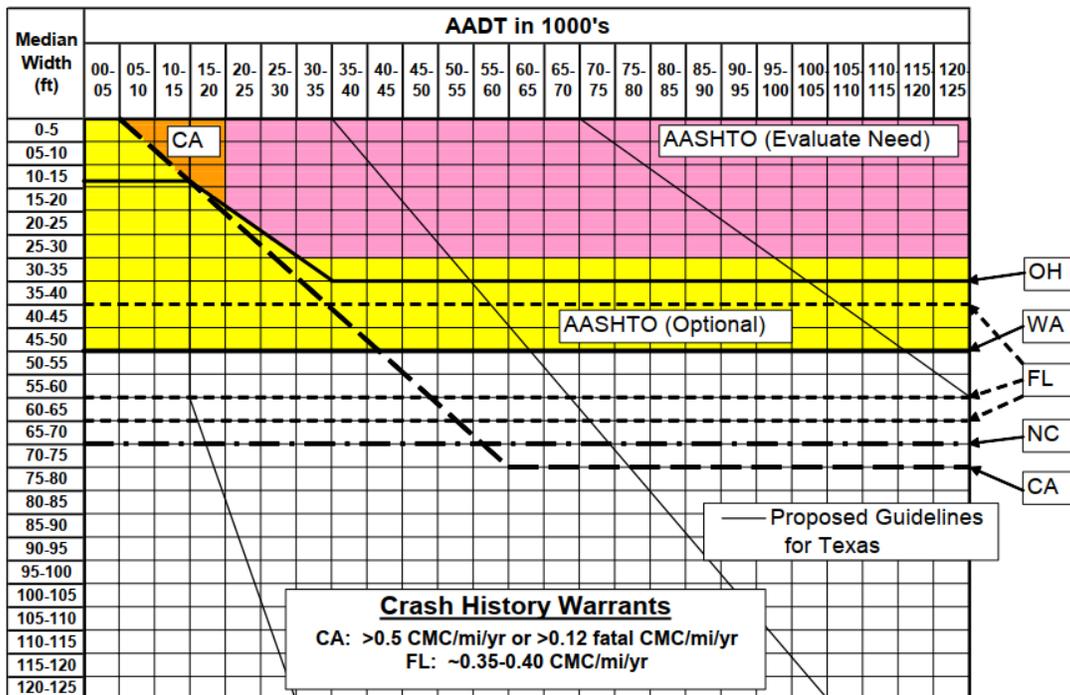


Figure 4: Graphical Summary of Existing Median Barrier Guidelines from AASHTO and Selected State DOTs (Source: Median Barrier Guidelines for Texas, TTI)

In Delaware, median barrier has been installed on the majority of access-controlled facilities through a programmed prioritization effort that accounted for median width, horizontal curvature, AADT and other considerations as being potential risk factors for cross-median crashes. Median barrier has been installed along the freeway portions of SR 1 which has a maximum median width of approximately 66-feet and AADTs ranging from 35,000 to 90,000 vehicles per day. Median barrier has been installed on the entire limits of I-495 which has a maximum median width of 85-feet and AADTs ranging from 67,000 to 120,000 vehicles per day. Median barrier has been installed along the majority of the I-95 corridor which has a maximum median width of approximately 85-feet and AADTs ranging from 50,000 to 235,000 vehicles per day.